

CHAPTER 4 & 5:
Sensation and Perception

How many senses do
you have?

Can you name them?

Your Nine Senses

External Senses: Hearing, sight, taste, touch, and smell.
They provide information about the outside world.

Internal Senses: Pain, balance, thirst, and hunger
They provide information about the body and its needs

For example, the sense of hunger shows that the body
needs food.

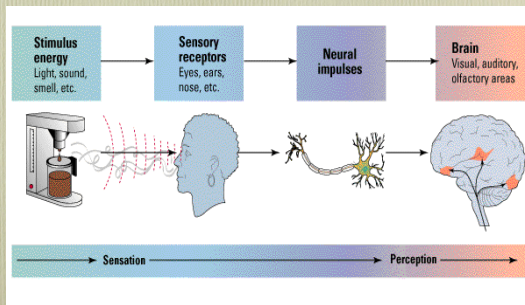
Feels pain and escapes pain.

What is the
difference between
sensation and
perception?

Sensation and Perception

- Sensation
 - The processes by which our sense organs receive information from the environment.
- Perception
 - The processes by which people select, organize, and interpret sensations.

Processes of Sensation & Perception



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Measuring Sensory Experience Thresholds

- **Absolute Threshold**
 - The smallest amount of stimulation that can be detected.
- **Just Noticeable Difference (JND)**
 - The smallest amount of change in a stimulus that can be detected.

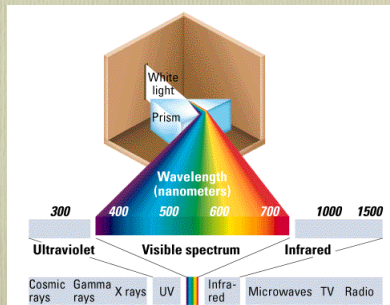
Measuring Sensory Experience Absolute Sensory Thresholds

- **Vision:** A single candle flame from 30 miles on a dark, clear night
- **Hearing:** The tick of a watch from 20 feet in total quiet
- **Smell:** 1 drop of perfume in a 6-room apartment
- **Taste:** 1 teaspoon sugar in 2 gallons of water
- **Touch:** The wing of a bee on your cheek, dropped from 1 cm

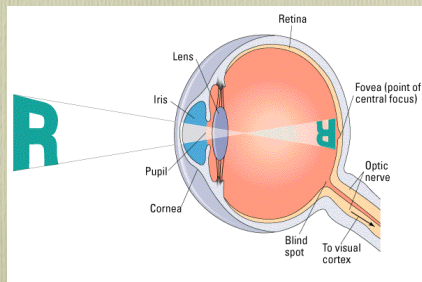
Sight

- 70% percent of the body's sense receptors cluster in the eyes
- **It is mainly through seeing the world that we appraise & understand it.**
- All the eye does is gather light.
 1. Lens - thins to focus on a distant object, which looks small and thickens to focus on a near one, which looks large.
 2. Iris - (a muscle), changes the size of a small hole (pupil), which lets light in
 3. Retina - Lines the rear wall of the eyeball includes two sets of photosensitive cells: rods, and cones.
 - (i) Rods report in black/white
 - (ii) Cones detect color.
- Seeing doesn't happen in the eyes but in the brain where the images are interpreted and meaning is associated.

Vision *The Electromagnetic Spectrum*

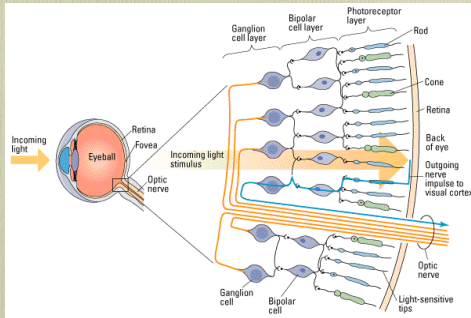


Vision *Structures of the Human Eye*



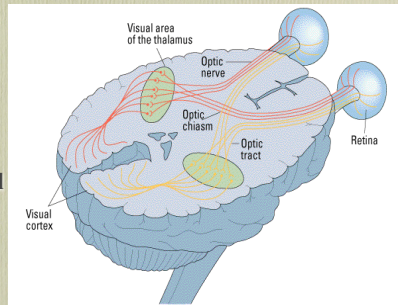
Vision The Retina

- The rear of the eye where rods and cones convert light into neural impulses.



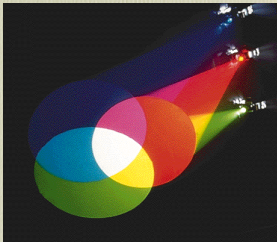
Vision Visual Pathways

- Optic Nerve
- Pathway that carries visual information from the eyeball to the brain.



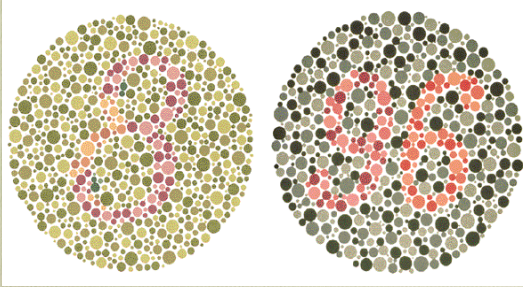
Vision Trichromatic Theory

- T. Young (1802) & H. von Helmholtz (1852) both proposed that the eye detects three primary colors: red, blue, & green.
- All other colors can be derived by combining these three.



Vision

Test of Color Deficiency



Hearing

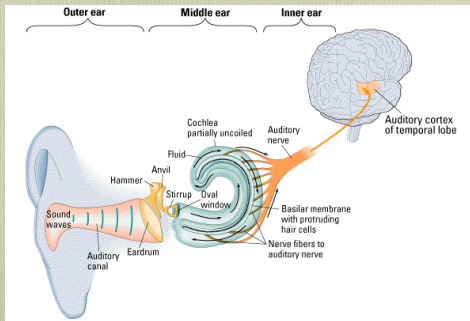
- Sound is produced by vibrating objects
- Sound has three characteristics: pitch, quality, and loudness.
 1. loudness - determined by the distance from the source, the intensity of the vibration, and the surface area of the vibrating object.
 2. pitch - determined by the speed of the vibration.
 - (i) faster vibration - higher pitch
 - (ii) slower vibration - lower pitch.
 3. quality - includes those characteristics that make one sound distinct from others.
 - (i) It is the quality of a sound that allows you to tell the difference between a car, a truck, or a wagon traveling down the street in front of your house.
- Sound is caused by a vibration in an object that travels as a wave of molecules & ripples out in all directions.
 1. Waves of sound travel to our ears where they make the eardrum vibrate.
 2. This moves the 3 tiniest bones in our body, the hammer, the anvil, & the stirrup.
 3. The bones press fluid in the inner ear against membranes, which brush tiny hairs that trigger nearby nerve cells, telegraphing messages to the brain.
 4. The brain then interprets the meaning of the sounds we hear.

Relationship Between Frequency and Loudness

- Here is an auditory demonstration of the relationship between frequency and loudness. **In the demonstration there are nine different frequencies (10, 20, 50, 100, 500, 1000, 5000, 10000, and 20000 Hz) each played for about 2 seconds each.** Each frequency is played at a constant amplitude, so the energy present is constant. Nonetheless, your experience of loudness should not be constant. **Thus, some frequencies will sound louder than others, even though the energy present is always the same. (In fact, you may not even hear some frequencies.)** Thus, your auditory system is more sensitive to some frequencies (between 1000 and 5000 Hz) than other frequencies that are much lower or much higher.
- <http://www.skidmore.edu/~hfoley/sounds/Step.wav>

Hearing The Human Ear

Audition • The sense of hearing

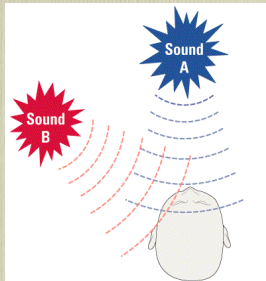


<http://www.hearingusa.com/earso1.mov>

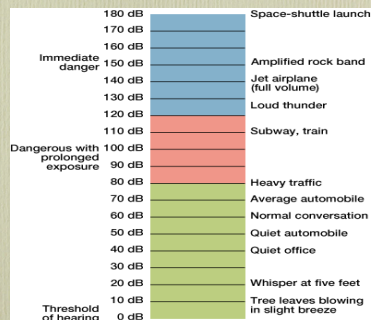
Hearing Auditory Localization

– The ability to judge from which direction a sound is coming

- Sounds from different directions are not identical as they arrive at left and right ears.
- The brain calculates a sound's location by using differences in timing and intensity.



Hearing Common Sounds and the Noise They Produce



Hearing Disabilities

Conduction Hearing Loss

- Caused by damage to the eardrum or bones in the middle ear. Can be corrected medically

Some possible causes of conductive hearing loss:

- Fluid in the middle ear from colds
- Ear infection (otitis media)
- Allergies (serous otitis media)
- Poor eustachian tube function
- Perforated eardrum
- Benign tumors
- Impacted earwax (cerumen)
- Infection in the ear canal (external otitis)
- Presence of a foreign body
- Absence or malformation of the outer ear, ear canal, or middle ear

Hearing Disabilities

Sensorineural Hearing Loss

- Caused by damage to the structures of the inner ear. Most of the time, SNHL cannot be medically or surgically corrected. This is the most common type of permanent hearing loss.

SNHL reduces the ability to hear faint sounds. Even when speech is loud enough to hear, it may still be unclear or sound muffled.

Some possible causes of SNHL:

- Illnesses
- Drugs that are toxic to hearing
- Hearing loss that runs in the family (genetic or hereditary)
- Aging
- Head trauma
- Malformation of the inner ear
- Exposure to loud noise

Smell

- Smell is the most direct of our senses.
- Molecules float back into the nasal cavity behind the bridge of the nose where they are detected by receptor cells.
- 5 million of these cells fire impulses to the brain's olfactory bulb or smell center.
- If you damage nerve endings in your eyes or ears, both organs will be irreparably damaged, but the neurons in the nose are replaced about every thirty days.

Smell

Smell is stored almost exclusively in the long-term memory.

1. Smells stimulate learning & information.
2. Edwin T. Morris noted that a list of words was recalled much more easily and retained better when olfactory information was given along with a word list.
3. Like primary colors or the four basic tastes, all smells fall into a few basic categories: minty (peppermint), floral (roses), ethereal/delicate & light (pears), musky (musk), resinous (camphor - aromatic), foul (rotten eggs), and acrid/unpleasant & strong (vinegar).

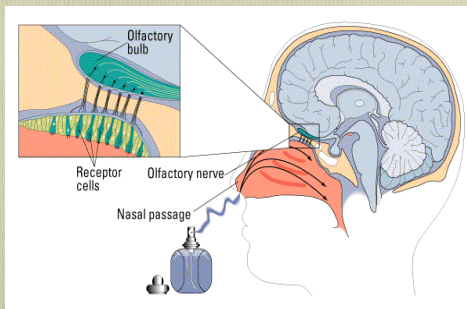
Smell

Only substances volatile enough to spray microscopic particles into the air have a smell.

1. When you smell chocolate chip cookies, you actually smell molecules of the cookie that have evaporated.
2. Each person has an odor as individual as a fingerprint.
3. In the absence of gravity, molecules will not float away easily, so the sense of smell is less effective.

Other Senses Olfactory System

• Structures responsible for the sense of smell



Sense-Sational Facts

- Dogs have 1 million smell cells per nostril and their smell cells are 100 times larger than humans!
- Humans use insect warning chemicals, called pheromones, to keep away pesky insects!
- If your nose is at its best, you can tell the difference between 4000-10,000 smells!
- As you get older, your sense of smell gets worse. Children are more likely to have better senses of smell than their parents or grandparents.

Taste

- Just as we can smell something only when it begins to evaporate, we can taste something only when it begins to dissolve.
- Adults have ~10,000 taste buds grouped at various sites in the mouth.
- Inside each taste bud, ~50 taste cells relay info. to the brain.
- Taste buds wear out every week to ten days & we replace them, although not as often over the age of 45.
- Our sense of taste is not as sharp as we get older.

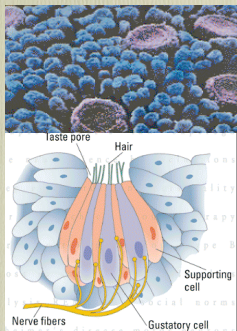
Other Senses

• Taste buds

Taste

– Nets of taste-receptor cells

- This is a photograph of the tongue's surface (top), magnified 75 times.
- 10,000 taste buds line the tongue and mouth.
- Children have more taste buds than adults do.
- There are four primary tastes: sweet, salty, sour, and bitter.



Sense-Sational Facts

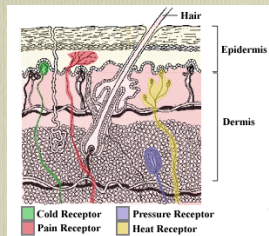
- We have almost 10,000 taste buds inside our mouths; even on the roofs of our mouths.
- Insects have the most highly developed sense of taste. They have taste organs on their feet, antennae, and mouthparts.
- Fish can taste with their fins and tail as well as their mouth.
- In general, girls have more tastebuds than boys.
- Taste is the weakest of the five senses.

Touch

- The skin is the largest organ of the body.
 1. weighs ~6-10 lbs
 2. 2 layers:
 - (i) Epidermis, or outer layer
 - (a) thin, scaly outer layer of the body that protects us from the outside environment.
 - (b) top layer - dead skin cells that are easily shed.
 - (ii) Dermis, or underlayer.
 - (a) The dermis protects and cushions the body.
 - (b) Includes: hair follicles, nerve endings, sweat glands, blood, & lymph vessels.
- Touch receptors sense pressure, pain, & temperature.
 1. The concentration of receptors varies
 - (i) fingertips, tongue, & lips - most sensitive areas b/c contains the greatest concentration of nerve endings.
 - (ii) The least sensitive part of your body is the middle of your back

Skin

- Beneath the skin lie nerve endings that send signals to the brain & the brain decides how to interpret the info



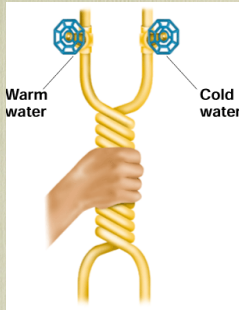
Other Senses

Temperature

- **The Thermal Grill**

When a person grasps two braided water pipes – one with cold water running through it and one with warm water – the sensation is “burning hot” and painful.

- There are two separate pathways for warmth and cold.



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Types of sense receptors:

- **Pressure**

- **Key areas of pressure receptors**

- Hands
- Lips

- **Sensory Adaptation**

- Adapt to constant stimuli and shut down
- w/o this you would be annoyed with all of the constant things you touch (ie. clothes, glasses, etc.)



Types of sense receptors:

- **Pain**

- **Two neural pathways**

- Fast
 - Intense pain calls for quick reaction
 - Need to prevent further damage to body
- Slow
 - Nagging pain
 - Oh right, I got a paper cut yesterday

- **State of mind affects extent of pain endurance**

- Excitement, adrenaline overrides pain
 - Athletes playing with broken bones
 - Soldiers fighting on during battle after getting shot



Types of sense receptors:

- **Temperature**
 - **Body quickly adapts to temps. b/n 60° – 106°**
 - **Cold receptors outnumber heat receptors 3 to 1**
 - Cold presents a greater threat to survival



Sense-Sational Facts

- You have more pain nerve endings than any other type.
- The least sensitive part of your body is the middle of your back.
- The most sensitive areas of your body are your hands, lips, face, neck, tongue, fingertips and feet.
- Shivering is a way your body has of trying to get warmer.
- There are about 100 touch receptors in each of your fingertips.

Reach Out & Touch Someone

Children deprived of touch can develop

PSYCHOSOCIAL DWARFISM

A condition whereby physical development is stunted



Pain in the ____ What?!?



Many times the pain is all in your head!

Stomachaches hurt yes....

But they hurt **more** when you are unhappy to begin with & have no plans for the evening, so you can sit & be miserable

Whereas, if you are out with friends & having fun... that same stomachache may simply be annoying



How should you think of pain?

Who has higher pain threshold:
men or women?

- An emotional experience of a physically distressing sensation

Men have 20% greater tolerance than women
But this may go more with the expression of pain, not the perception of it!



BBC Touch Video clips

BBC Touch video

<http://www.youtube.com/watch?v=XF1yxGRnmI>

1:38 - 2:23 painful stunts

2:43 - 3:40 Touch to explore the world **

3:50 - 5:15 monkeys **

5:20 - 7:20 massage **

7:50 - end Elephant

<http://www.youtube.com/watch?v=UrtDpKQp4to&feature=related> **show whole

0:20:30 papercut, touch signals @ beginning

2:03 - 4:23 confronting pain, stop noticing clothes, remove person's watch

4:24 - 8:00 expectation of pain

8:04 - dentist chair - control the amount of pain we feel - long set up

9:26 chronic pain treatment through hypnosis

<http://www.youtube.com/watch?v=p1pfoxUJnuA&feature=related>

beginning - 2:00ish hypnosis to control pain

**test not necessary - only show first two minutes

Other Senses

Pain

- Gate-control Theory
 - Theory that the spinal cord contains a neurological “gate” that blocks pain signals from the brain when flooded by competing signals.
- Psychological control
 - Mind over sensation, distraction

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Creating a Sensation

Have you ever sensed someone was untrustworthy?

Does smelling your Grandma’s perfume make you feel cozy?

Does holding your boy/girl friend’s hand make you tingle?

Have you ever thanked someone for cooking you a tasty meal?

All of this is in your head!

- How you react to stimuli is all based on your perception of the world
- The physical world is the same for each of us, but the mental world is different
- Psychophysics** – the study of psychological reactions to physical stimuli
- Is this play on senses used to attract and hold consumers?

Keeping the Signals Straight

- Synesthesia
 - Rare condition in which stimulation in one sensory modality triggers sensations in another sensory modality.
 - <http://faculty.washington.edu/chudler/syne.html>
 - <http://web.mit.edu/synesthesia/www/>
- Each sensory system is designed to operate separately from the others.
- Sensory Adaptation
 - A decline in sensitivity to a stimulus as a result of constant exposure.

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Perception is.....

Perception refers to the interpretation of what we take in through our senses, in terms of optical illusions this means our eyes.



Optical Illusions...

... occur because our brains try to interpret what we see and make sense of the world around us.

... simply trick our brains into seeing things that may or may not be real.



How do they work?

How do optical illusions trick our brains?

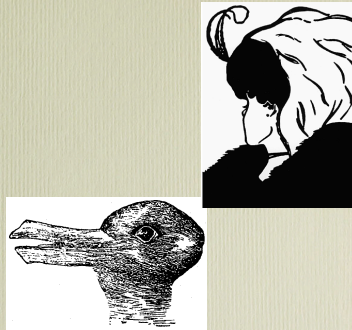
- In order to make sense of the world, our brains try to see patterns or shapes that we can easily recognize. This principle is called 'grouping'. Our brains can group things into four types:
- Similarity Proximity Continuity Closure

Perceptual Organization Reversible Figures

- Drawings that one can perceive in different ways by reversing figure and ground.

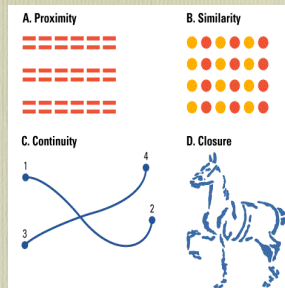
• Gestalt Psychology

- School of thought rooted in the idea that the whole is different from the sum of its parts.



Perceptual Organization Gestalt Laws of Grouping

- Proximity
 - Seeing 3 pair of lines in A
- Similarity
 - Seeing columns of orange and red dots in B
- Continuity
 - Seeing lines that connect 1 to 2 and 3 to 4 in C
- Closure
 - Seeing a horse in D



Depth Perception

Monocular Cues - need only one eye to be perceived. Artists use monocular cues to create an illusion of depth or 3D on 2D (flat) surfaces.

Binocular Cues for depth - both eyes needed. Depth is retinal disparity and convergence. Bring a finger to your nose; relax your eyes - you will see two images (retinal disparity - the closer the finger to your nose, the farther apart the fingers are.)

Depth and Dimension

Monocular Depth Cues

- Distance cues that enable the perception of depth with one eye.
 - Relative Image Size
 - Texture Gradient
 - Linear Perspective
 - Interposition
 - Atmospheric Perspective
 - Relative Elevation
 - Familiarity

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Depth and Dimension

- Depth Perception
 - The use of visual cues to estimate depth and distance.
- Convergence
 - A binocular cue involving the turning inward of the eyes as an object gets closer.
- Binocular Disparity
 - A binocular cue whereby the closer an object is, the more different the image is in each retina.

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Constancy

Size Constancy - perceive an object as being of one size no matter how far away the object is.

Take a look at the photograph and see if all the people in it all look reasonably the same size.

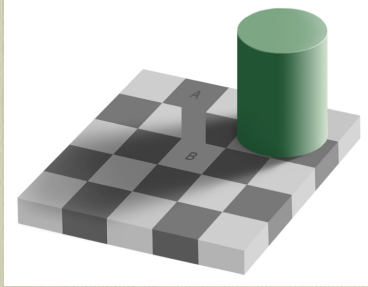


Which figure is bigger? Are you sure?

Constancy

Color Constancy - perceive objects as keeping their color even though different light might change the app. of their color.

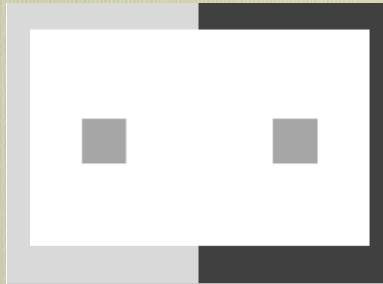
Which is darker
A or B?



Constancy

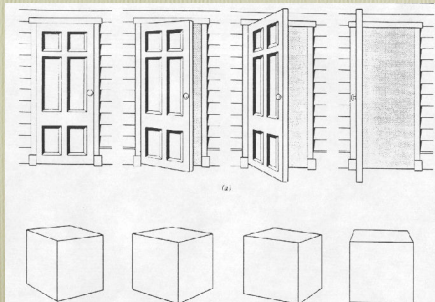
Brightness Constancy - perceive an object as being equally bright even when the intensity of the light around it changes.

Which is brighter
left or right?



Constancy

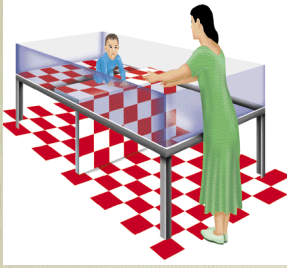
Shape Constancy - shape stays the same even if it changes position.



Depth and Dimension

The Visual Cliff

- Devised by Eleanor Gibson and Richard Walk to test depth perception in infants and animals.
- Provides visual illusion of a cliff.
- Caregiver stands across the gap.
- Babies are not afraid until about the age that they can crawl.



<http://www.youtube.com/watch?v=eyxMqUxWzM>

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Motion Illusions

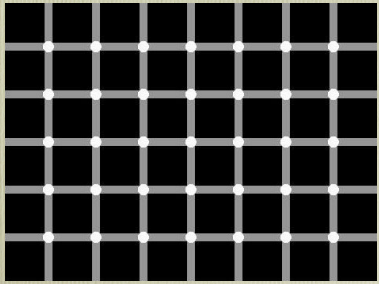
Perception of Movement: Are you moving or the car next to you? Check out stationary objects to determine what is moving.

Stroboscopic Motion: Showing the rapid progression of images or objects that are not moving at all produces illusions. Old flip books/movies today

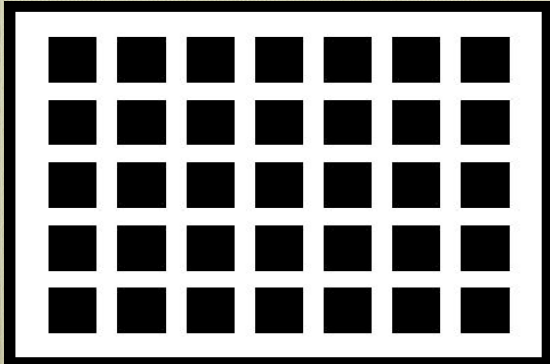
Spiral Aftereffect

- [Spiral aftereffect](#)

Scintillation Grid



Count the little black balls... This illusion was found by Elke Lingelbach and is a modification of an illusion called the [Hermann Grid](#), which dates from 1870



Find the faces

Pictographic ambiguity - where a single drawing has more than one 'image' contained within it, depending on how you look at it.

My wife
and my
mother-in-
law



Figure-Ground Perception



The perception of figures
against a background *
Two or more figures in
one view - clouds in a
blue sky * Vase/face
picture

Where?

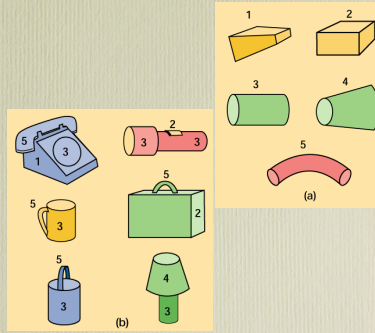
Many of the illusions in this powerpoint are from:

- http://www.grandillusions.com/opticalillusions/leaning_towers/
- <http://www.michaelbach.de/ot/>

Perceptual Organization

Identifying Objects

- Geons (geometric icons) are simple 3D component shapes.
- A limited number are stored in memory.
- Geons are combined to identify essential contours of objects.



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Perceptual Set

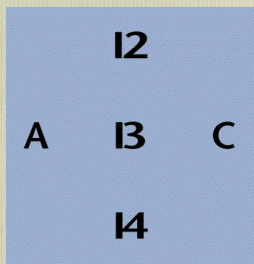


- What is seen in the center figures depends on the order in which one looks at the figures:
 - If scanned from the left, a man's face is seen.
 - If scanned from the right, a woman's figure is seen.
- This demonstrates the effects of one's **perceptual set**.

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Perceptual Set Context Effects

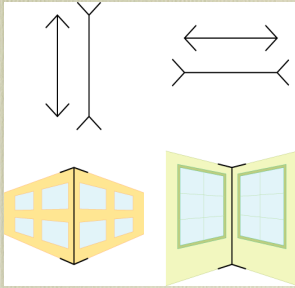
- The same physical stimulus can be interpreted differently depending on perceptual set, e.g., context effects.
- When is the middle character the letter B and when is it the number 13?



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The World of Illusions *The Müller-Lyer Illusion*

- Illusion in which the perceived length of a line is altered by the position of other lines that enclose it



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Extrasensory Perception

- The Case for ESP
- The Case against ESP

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The Case for ESP

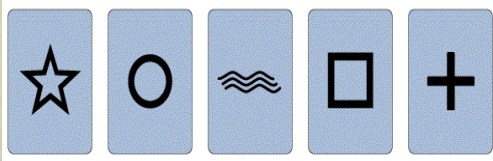
- Extrasensory Perception (ESP)
 - The ability to perceive something without ordinary sensory information.
 - This has not been scientifically demonstrated.
- Parapsychologists distinguish between three types of ESP:
 - Telepathy – Mind-to-mind communication
 - Clairvoyance – Perception of remote events
 - Precognition – Ability to see future events



Minority Report

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The Case against ESP
ESP Cards



- J. B. Rhine conducted many experiments on ESP using stimuli such as these.
- Rhine believed that his evidence supported the existence of ESP, but his findings were flawed..